A PRELIMINARY ANALYSIS OF THE EFFECTS OF RESPONSE CARDS ON STUDENT PERFORMANCE AND PARTICIPATION IN AN UPPER DIVISION UNIVERSITY COURSE

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We evaluated the effects of response cards on student quiz scores and participation in an upper division undergraduate course at a small, private university. Results showed that response cards increased both quiz scores and student participation. In addition, a measure of the social validity of the response-card procedure suggested that students approved of the use of the cards.

DESCRIPTORS: academic behavior, college teaching, higher education, response cards

Despite much debate on the issue, lecturing continues to be one of the most common methods of instruction in college courses. One of the most frequent criticisms of lecturing has been that the instructor typically does the majority of the teaching and the students may only passively attend. In other words, students rarely become actively involved with instruction during most lectures.

Research has shown that interaction with instructors increases learning (Greenwood, Delquadri, & Hall, 1985; Martin, Pear, & Martin, 2002). One way that behavior analysts have increased student interaction during lectures is with response cards. Response cards are cards or signs that are simultaneously held up by all students in a class to display an answer or other response to a teacher-delivered question. Previous research has demonstrated that the use of response cards can increase student participation (Gardner, Heward, & Grossi, 1994; Narayan, Heward, Gardner, Courson, & Omness, 1990) and test scores (Cavanaugh, Heward,

& Donelson, 1996; Gardner et al.) among primary and secondary education students. More recently, Kellum, Carr, and Dozier (2001) showed that the use of response cards increased student quiz scores and participation in a moderate-sized introductory course at a community college. However, response-card instruction has not been evaluated in other college settings. The purpose of the present study was to evaluate the use of response cards in an upper division undergraduate course at a small, private university.

METHOD

Participants and Setting

Twenty-seven psychology majors enrolled in an undergraduate Psychology of Learning class participated in the study (6 men and 21 women). The class met for 75 min two to three times per week. The ages of the participants ranged from 18 to 23. All of the participants were in their 3rd or 4th year at a small, private university in the western United States.

Dependent Variables and Design

Dependent variables for the study were scores on a postlecture quiz and number of incidents of student participation per class
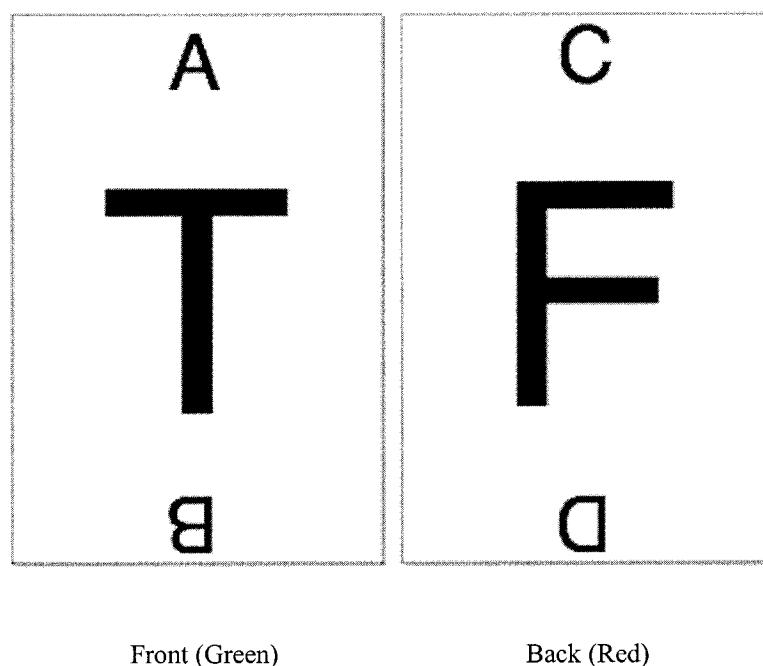
Front (Green)   Back (Red)

Figure 1.   Illustration of the laminated, two-color response card. The letters correspond to answers to true–false (T, green; F, red) and multiple-choice (A, B, C, D) questions.

meeting. Quiz scores were determined by scoring each individual quiz and averaging the percentage of correct questions across the class. Student participation was scored via videotape. For each class, a research assistant counted the number of raised hands, call-out answers, and response-card displays that took place per class period. If more than 1 student called out an answer simultaneously, all students who responded were counted (the videotape included audio recording). At no time did more than 2 students simultaneously call out an answer. The number of raised hands, call-out answers, and response-card displays were added together to form a total student participation score per class. This number was then divided by the number of students in attendance for that class period to obtain a mean number of student responses for each class meeting. Student participation data for two class meetings (Meetings 5 and 9) were unavailable due to technical difficulties with the videotape. An alternating treatments design with a baseline was used to evaluate the effects of the response cards on quiz scores and student participation.

Materials and Procedure

During response-card lectures, students were provided with a laminated, two-color card (20.3 cm by 11.7 cm) that contained letters that corresponded to answers (see Figure 1). Students displayed answers by holding up a response card with their chosen answer facing the front of the classroom. Quizzes were delivered on paper (21.6 cm by 28 cm). Students wrote their answers directly on the quizzes.

Prior to each class period, the instructor created six true–false and multiple-choice questions that were posed verbally during the course of the lecture (except during baseline). The instructor also prepared an 8- to 10-question postlecture quiz that assessed student knowledge of the lecture material. The questions that were included on the quiz tested the same material that was pre-

sented as part of the six questions during lecture, but the questions were not identical. The lecture questions and quiz questions tested the same concept or principle, but the wording and response options were completely different. Each quiz included four or five true–false questions and four or five multiple-choice questions across all conditions (i.e., the number and format of quiz questions remained identical across the three conditions). Because response-card and standard lectures were determined at random using a coin flip by the instructional assistant 1 min before class began, the instructor was never aware of which class period would be a response-card lecture. On entering the classroom, the instructor found an envelope that contained response cards to be distributed to the class on response-card days. On non-response-card days, the instructor found an envelope with a page inside that said "NO RC."

Each class meeting consisted of a lecture. During the response-card and standard lecture conditions, the instructor verbally posed six prewritten questions for students to answer. After each question, the instructor verbally presented either two (T, F) or four (A, B, C, D) possible answers to the question. Each question was read twice, and each response option was repeated three times to help students remember the response choices.

Baseline. Class meetings during the baseline phase were identical to those in the standard lecture condition, with the exception that the six prewritten questions were not formally presented during class. Any time a student answered an informal question by speaking out in class or spoke out to ask a question related to class material, an instance of participation was recorded.

Response-card condition. During the first response-card lecture, the instructor taught the students to respond to the six prewritten lecture questions using the response cards. Students were told to respond to the questions by clearly displaying the card with the corresponding answer facing upright and towards the instructor. During response-card lectures, the instructor posed questions and observed the responses of the class. After the class responded, the instructor read the correct answer. If more than 75% of the class responded correctly, the instructor continued to the next topic. If fewer than 75% of the class answered correctly, the instructor reviewed the material. The review consisted of a brief (two- or three-sentence) explanation of the issue targeted by the question.

Standard lecture condition. On standard lecture days, the six prewritten questions were posed to the class. However, in this condition, students answered the questions (e.g., "Who thinks A is correct? Who thinks B is correct?") by raising their hands. All response options were delivered in a separate question (e.g., both "Who thinks this is true?" and "Who thinks this is false?" were presented for each question). In addition, any time a student spoke out in class to ask a question related to class material, it was recorded as an instance of participation. After the students answered the question, the instructor stated the correct answer. If 75% or more students answered incorrectly, the instructor reviewed the material in a manner identical to that of the response-card condition.

At the end of each lecture in all three conditions, students were provided with the 8- to 10-question true–false and multiple-choice quiz that assessed their knowledge of the material presented in that day's lecture.

Interobserver Agreement

The course instructor and an independent grader scored all postlecture quizzes and videotape recordings of class lectures for the student participation measure. For quizzes, total agreement was calculated on a question-by-question basis by taking the number
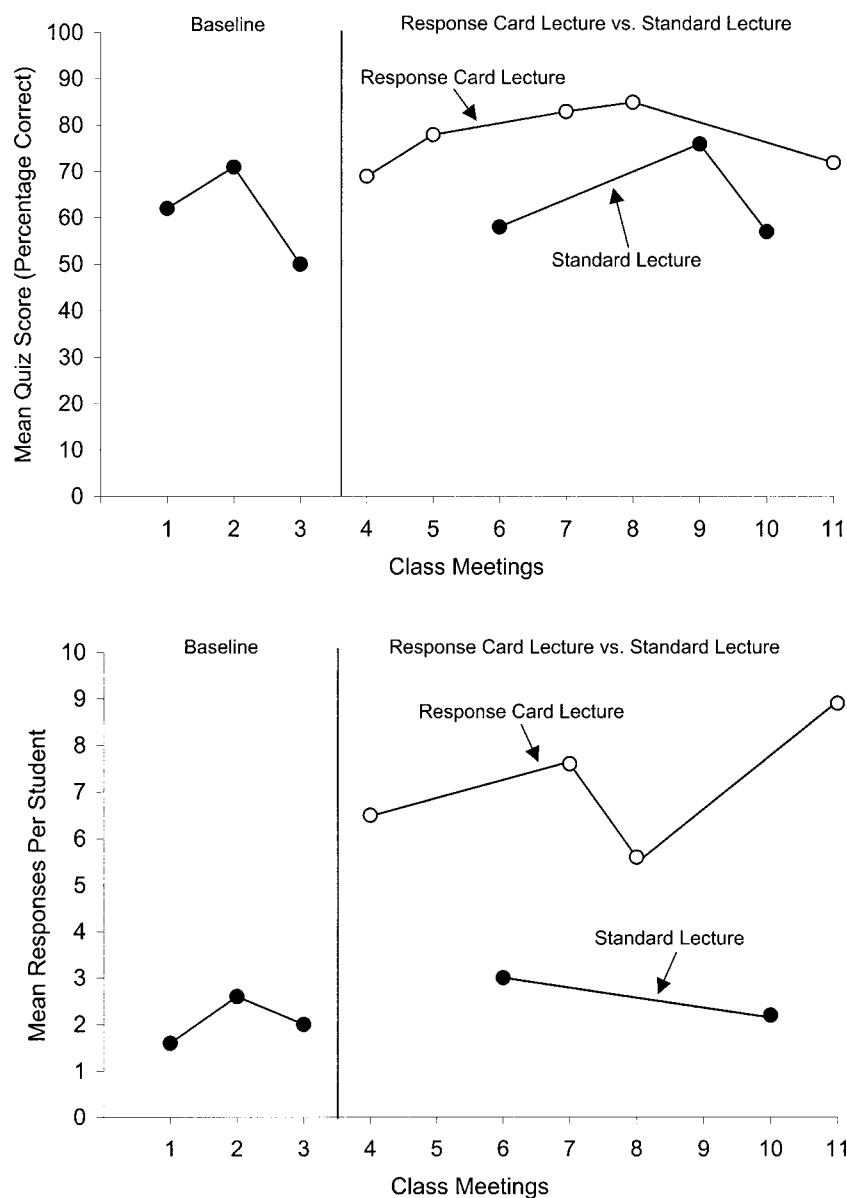
Figure 2.   The top panel depicts the mean daily postlecture quiz score across baseline, response-card lectures, and standard lectures. The bottom panel depicts mean responses per student across baseline, response-card lectures, and standard lectures. Class Meetings 5 and 9 are not included in the bottom panel; these data were unavailable.

of questions on which the responses were identical across the two graders, dividing by the total number of questions, and multiplying by 100%. Mean agreement for the postlecture quizzes was 100%. For student participation, interobserver agreement data were calculated for 67% of class meetings.

The total number of student responses per class period was tallied by each of the two observers. Agreement per class period was calculated by dividing the smaller frequency by the larger frequency and multiplying by 100%. Mean agreement for student participation was 85% (range, 78% to 100%). In-

dependent variable integrity data were also collected on presentation of questions and coverage of quiz content during lectures. All questions were presented during 100% of lectures, and the content covered on the quiz was presented during 100% of lectures.

RESULTS AND DISCUSSION

The top panel of Figure 2 depicts end-of-class quiz scores across baseline, response-card lectures, and standard lectures. During baseline, the mean quiz score was 61% (range, 50% to 71%). During response-card lectures, the mean quiz score was 73.4% (range, 69% to 85%). During standard lectures, the mean quiz score was 63.6% (range, 57% to 76%). In addition, a detailed analysis of individual student quiz scores revealed that 54% of students exhibited improved quiz scores during the response-card lectures. This effect was more pronounced among low-performing students; 75% of students scoring below 60% on quizzes during baseline improved their performance during the response-card condition.

The lower panel of Figure 2 depicts student participation across baseline, response-card lectures, and standard lectures. During baseline, the mean number of responses per student was 2 (range, 1.6 to 2.6). During response-card lectures, the mean number of responses per student was 7.2 (range, 5.6 to 8.9). During standard lectures, the mean number of responses per student was 2.6 (range, 2.2 to 3). In addition, a detailed analysis of individual student responding revealed that 96% of students exhibited increased responding during the response-card lectures.

These results support the use of response cards to increase student learning (as measured by quiz scores) and participation in an upper division undergraduate course at a small, private university. Only one study (Kellum et al., 2001) has demonstrated the utility of response cards at the college level (i.e., at a community college). The results of the current study expand the demonstrated utility of response cards to a novel type of college course and population.

At the conclusion of the study, all students completed a questionnaire designed to measure the social validity of the response-card procedure. Seventy-nine percent of students reported that the response cards improved their attention to the lecture. Eighty-seven percent of students reported that they would suggest that more professors use response cards in their lectures. Some additional comments regarding the response cards were that they "were fun," "encouraged interaction," and that they seemed to "prompt the instructor to be more interactive and interested in the topic." Only 1 student made a negative comment, that the cards seemed "childish."

Although these results are notable, they should be considered preliminary. One limitation is that the difference in mean quiz scores across the standard and response-card conditions was only about 10% (63.6% vs. 73.4%, respectively) and there was some overlap in data between the two conditions, thus limiting the extent to which conclusions can be made about the relative effectiveness of response cards. Nevertheless, this 10% difference translates into a full letter grade in an academic course (e.g., from a D to a C). Future research should investigate the optimal number of response-card questions to include during lectures. It may be that too many questions may actually interfere with student performance.

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